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# CBRN Canister Requirements

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# CBRN Canister Requirements

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- The requirements for the PAPR canister testing will be based on the same tests as for the Air Purifying Respirator Canisters.

*Statement of Standard for Chemical, Biological, Radiological, and Nuclear (CBRN) Full Facepiece Air Purifying Respirator (APR), Dated March 7, 2003*

- Hazard list derived during earlier CBRN standards development work.

# CBRN Canister Requirements

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## Test Representative Agent

- **Organic vapor family** – cyclohexane
- **Acid gas family** –  $\text{SO}_2$ ,  $\text{H}_2\text{S}$ ,  $\text{CNCL}$ ,  $\text{COCl}_2$ ,  $\text{HCN}$
- **Base gas family** – ammonia
- **Hydride family** – phosphine
- **Nitrogen oxide family** – nitrogen dioxide
- **Formaldehyde family** – formaldehyde
- **Particulate family** – DOP

# CBRN Canister Requirements

| TRA                 | Challenge Concentration (ppm) | Breakthrough Concentration (ppm)   |
|---------------------|-------------------------------|------------------------------------|
| • Cyclohexane       | 2600                          | 10                                 |
| • Sulfur dioxide    | 1500                          | 5                                  |
| • Hydrogen sulfide  | 1500                          | 5                                  |
| • Cyanogen Chloride | 300                           | 2                                  |
| • Phosgene          | 250                           | 1.25                               |
| • Hydrogen Cyanide  | 940                           | 4.7                                |
| • Ammonia           | 2500                          | 12.5                               |
| • Phosphine         | 300                           | 0.3                                |
| • Nitrogen dioxide  | 500                           | 1 ppm NO <sub>2</sub> or 25 ppm NO |
| • Formaldehyde      | 500                           | 1                                  |

# CBRN Canister Requirements

•Terminology used for capacity of canisters will now be “Capacities 1 thru 6”

| Filter Capacity | Test Time (min) | Filter Capacity (ppm-min) |
|-----------------|-----------------|---------------------------|
| Capacity # 1    | 15              | Test Concentration X 15   |
| Capacity # 2    | 30              | Test Concentration X 30   |
| Capacity # 3    | 45              | Test Concentration X 45   |
| Capacity # 4    | 60              | Test Concentration X 60   |
| Capacity # 5    | 90              | Test Concentration X 90   |
| Capacity # 6    | 120             | Test Concentration X 120  |

# CBRN Canister Requirements

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## PAPR type

- PAPR concept allows for different operational technologies:
  - **Constant flow PAPR**
    - Moderate breathing performance
    - High breathing performance
  - **Demand response PAPR**
    - Moderate breathing performance
    - High breathing performance

# CBRN Canister Requirements

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## Constant Flow PAPR

- **Manufacturer will apply for**
  - Moderate breathing rate performance
  - High breathing rate performance
- **Manufacturer specifies filter capacity**
  - Capacities 1 through 6

# CBRN Canister Requirements

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## Constant flow PAPR Airflow for service life testing

- Service life testing of canisters performed at airflow of blower or a minimum flow depending on manufacture specified breathing rate performance
- Intend on looking at ways of measuring actual flow rates through the canister over a specific period of time for a PAPR unit
- Moderate breathing rate performance minimum is 100 Lpm
- High breathing rate performance minimum is 261 Lpm

# CBRN Canister Requirements

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## Constant flow PAPR

- Three tests at 25% RH, 25°C at capacity requested
- Three tests at 80% RH, 25°C at capacity requested
- Three tests for crisis provision capacity
- For multiple canister configuration PAPR units, the airflow for service life testing will be reduced in proportion to the number of canisters
- For PAPRs with a single canister element, the canister shall be tested at a continuous airflow rate of the measured airflow

# CBRN Canister Requirements

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## Demand Responsive PAPR

- Manufacturer will apply for
  - Moderate breathing rate performance
  - High breathing rate performance
- Manufacturer specifies filter capacity
  - Capacities 1 through 6

# CBRN Canister Requirements

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## Demand responsive PAPR

### Airflow for service life testing

- Moderate breathing rate performance PAPR tested at 115 Lpm
- High breathing rate performance PAPR tested at 300 Lpm
- Intend on looking at ways of measuring actual flow rates through the canister over a specific period of time for a demand responsive unit

# CBRN Canister Requirements

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## Demand responsive PAPR

- Three tests at 25% RH, 25°C at capacity requested
- Three tests at 80% RH, 25°C at capacity requested
- Three tests for crisis provision capacity
- For multiple canister configuration the airflow will be reduced in proportion to the number of canisters
- For PAPRs with a single canister element, the canister shall be tested at a continuous airflow rate of the measured airflow or the minimum (which ever is greater)

# CBRN Canister Requirements

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## Crisis provision

- Constant flow and demand responsive PAPR
- Three tests at 430 Lpm 50% RH, 25°C for minimum service life of 5 minutes
- Intend on looking at ways of establishing a crisis flow rates through the canister over a specific (short) period of time for a PAPR unit

# CBRN Canister Requirements

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## Protection Stacking

- Additional protection can be added by increasing the category of one or more of the six chemical agent families
- All TRAs for the chemical agent family must pass the higher capacity test
- Example: Manufacture requested a CBRN Cap 1 / Acid Gas Cap 2 / OV Cap 3

# CBRN Canister Requirements

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## Protection of CBRN Cap 1 / Acid Gas Cap 2 / OV Cap 3

### CBRN Cap 1:

Nitrogen dioxide – 15 minutes

Formaldehyde – 15 minutes

Phosphine – 15 minutes

Ammonia – 15 minutes

### Acid gas Cap 2:

Cyanogen chloride – 30 minutes

Hydrogen Cyanide – 30 minutes

Hydrogen sulfide – 30 minutes

Sulfur dioxide – 30 minutes

Phosgene – 30 minutes

### OV Cap 3:

Cyclohexane – 45 minutes

# CBRN Canister Requirements

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## Additional requirements being considered

- Canister uniformity
  - Canisters must have uniform resistance within the population tested at a prescribed flow rate
  - Average will be determined from initial resistance tests
  - Variance between the population must remain at defined range

# CBRN Canister Requirements

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## Additional performance being considered

- Tests to determination the airflow from individual canister connections on the manifold
- Engineering evaluation of differences in manifold airflows, taken into account in the airflow rate for service life testing

# CBRN Canister Requirements

## Systems vs. Individual Canisters

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### Ongoing Concern during Testing

- Uniformity of canister resistance
- Uniformity of manifold configuration
- Time and cost of service life testing

# CBRN Canister Requirements

## Systems vs. Individual Canisters

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Three concepts are being investigated to handle these concerns.

1. Individual canister testing; separation of canisters from manifold for testing
2. Systems testing; manifold and canisters as a whole
3. A combination of the individual and systems test

# CBRN Canister Requirements

## Systems vs. Individual Canisters

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- Individual canister testing
  - 3 canisters 25% RH, 25°C, proportional airflow of blower + percentage increase of flow or time for safety factor
  - 3 canisters 80% RH, 25°C, proportional airflow of blower + percentage of flow or time for safety factor
  - 3 canisters crisis provision
  - Evaluation of equal flow characteristics of the manifold

# CBRN Canister Requirements

## Systems vs. Individual Canisters

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- Systems testing
  - 3 systems (blower fixture and canisters), 25% RH, 25°C, airflow of blower
  - 3 systems (blower fixture and canisters), 80% RH, 25°C, airflow of blower
  - 3 systems (blower fixture and canisters), crisis provision

# **CBRN Canister Requirements Systems vs. Individual Canisters**

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- Individual canisters and system combination
  - 3 canisters, 25% RH, 25°C, proportional airflow of blower
  - 3 canisters, 80% RH, 25°C, proportional airflow of blower
  - 3 canisters crisis provision
  - Complete manifold with canisters tested at airflow of PAPR against worst chemical or short list of chemicals

# **CBRN Canister Requirements**

## **Systems vs. Individual Canisters**

### **Pros and Cons**

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- Individual canisters testing
  - Cost; fewer dollars in chemical cost
  - Fewer canisters used for testing
  - Does not account for flow variations in manifold and canisters resistances
  - Deviates from traditional requirements of systems testing described in 42 CFR part 84

# **CBRN Canister Requirements**

## **Systems vs. Individual Canisters**

### **Pros and Cons**

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- **Systems testing**
  - **Much higher cost for chemicals**
  - **More canisters required for testing**
  - **Cost in additional test manifolds**
  - **Will account for flow variations in manifold and canisters resistances**
  - **Meets traditional requirements of systems testing described in 42 CFR part 84**

# **CBRN Canister Requirements**

## **Systems vs. Individual Canisters**

### **Pros and Cons**

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- **Combination testing**
  - Lower cost for chemicals
  - Fewer canisters required for testing
  - Fewer test manifolds
  - Will account for flow variations in manifold and canisters resistances

# CBRN Canister Requirements

## Questions and Comments

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